

Spore Cleaning Efficiency Study Using Ten Spacecraft Materials

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Abstract

To limit transport of terrestrial microorganisms to other planets via a spacecraft, the spacecraft components must be cleaned during the assembly process. Cleanliness must also be maintained throughout subsequent assembly and launch preparations. A procedure currently used at NASA's flight hardware facilities is cleaning with wipes saturated with 100% isopropyl alcohol (IPA). In this study, we have evaluated the efficiency of a variety of cleaning procedures for ten commonly used spacecraft materials. We inoculated known amounts of *Bacillus pumilus* spores onto coupons of the materials by using a robotic Beckman Coulter Biomek dispenser system. Eleven cleaning conditions with variant combinations of solvents and wipe materials were evaluated and the most effective cleaning protocol was identified. We chose *Bacillus pumilus* for this study because it is a spore that has been repeatedly isolated from spacecraft assembly facilities. The results showed that the best solvent system for effectively cleaning *Bacillus pumilus* from material surfaces is ~50% IPA. Ironically, the current 100% IPA protocol is among the least efficient cleaning methods for cleaning spacecraft surfaces contaminated with this particular contaminant. These results are consistent with a similar cleaning study conducted previously on surfaces contaminated with gram-negative bacteria. In this present study, we have also found that surface properties play a significant role in determining the cleanability of the material. The best solvent composition, the most effective wipes, and the best and worst material and surface treatments have also been identified.